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CONFERENCE TITLE: Electro-active Polymer Actuators and Devices (EAPAD) (ss04) **CONFERENCE CHAIR**: Yoseph Bar-Cohen, Jet Propulsion Lab.
ABSTRACT TITLE: Equivalent Circuit of Ionic Polymeric Metal Composites
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ABSTRACT TEXT: In recent years the use of ionic polymer metal composites such as Nafion-based platinum composites have emerged as electroactive polymer materials with great potential for robotics and other applications. An effective activation of these materials requires understanding of their mechanism of operation as well as their interaction of the electrical field with the ionic constituents. Studies have shown a complex relation that depends on the moisture level, the spectral characteristics and of the activation field as well as the material processing. Generally, the material needs to be maintained moist to assure its electromechanical activity. To allow the control of the response of the material to electroactivation a study is underway to develop an equivalent circuit that describes the electrical and mechanical behavior in reaction to an electric input. Measurements have shown that the impedance is a strong function of the water content with values in the range of 40 to 100 ohms over operational frequencies (< 15 Hz). Plots of the real and imaginary components of the impedance at low frequencies are showing straight lines with slopes near -1.0 (i.e. phase angle is about -45 degrees). This behavior suggests that the current response to an applied voltage is dominated by the diffusion rates of ionic species to the electrodes (Warburg Impedance). Efforts are currently being made to determine the necessary drive characteristics of the source to allow low power operation of the material as an actuator. Pulses with different spectral characteristics are being explored to minimize the Joule heating that is associated with the energy losses.

KEY WORDS: Electroactive Polymers, Artificial Muscles, Actuators, Ionomers, Equivalent Circuits.

BRIEF BIOGRAPHY: Dr. Sean P. Leary joined the JPL's NDE& Advanced Actuators (NDEAA) in 1998. His areas of research are involved with the development of electroactive polymer actuators and mechanisms. He received the B.S.E in materials science and engineering from the University of Pittsburgh in 1994 and a Ph.D. in ceramic science from the New York State College of Ceramics at Alfred University in 1998. His research interests include piezoelectrics, electromechanical coupling in nonlinear electrostrictive materials, and ultrasonic methods for NDE.